INSTRUCTOR MATERIALS

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Activities

Activity 5-1
Scenario

Time: 0930 Hours
Weather: Cloudy, wind out of the northeast
Temperature 52°F

You receive a medical call from the dispatcher, a patient with difficulty breathing. You are sent to assist an ambulance enroute to a warehouse in an industrial park. You are to meet the caller at the loading dock on the east side of the warehouse.

Upon arrival, you notice very little activity. The company is Environmental Enterprises, Inc. This is a company which, among other things, cleans tanks and water blasts graffiti, provides deep well monitoring and does site clean-up and remediation.

On the loading dock you meet a mechanic who says he placed the emergency call for himself. His B/P is 162 over 98. Respirations are 18 and shallow. His chief complaint is respiratory distress and nausea.

He says he was working on the lighting in a trailer, trying to repair some fixtures and a short in the wiring. He has been at work since 0730 that morning, and in the trailer for about an hour. His ladder slipped while repairing the light on the ceiling of the trailer, causing him to fall against one of the containers. He landed on his side.

You send a fire fighter to the trailer to find out what is inside. The fire fighter returns and tells you no hazards are readily apparent. There is no product leaking onto the floor, nor are there any placards outside of the trailer. There are, however, several drums with hazardous waste stickers and what look like yellow and white labels. These containers were in the dark forward end of the trailer.

You decide to investigate a little further. On one of the drums, you can see the corner of a Radioactive-II label. You take a better look with your flashlight. The number .5 is written in the transport index box on the Radioactive-II label.

The ambulance is just pulling into the yard.

1. How would you characterize the scenario?

2. How would you treat the patient?

3. What hazards are involved?

Activity 6-1

Briefly review the Cleveland Aetna Plating Fire case study with the students. Then show Part 5 of the FRO Refresher/Radiation videotape with the news clip of that fire. Stop the tape and have the students discuss the following questions:

1. In this incident, more than two dozen fire fighters were admitted to area hospitals for observation. How could these injuries have been prevented?

2. What are the hazards of the chemicals involved? What is the appropriate protective equipment? (Have the students look up cyanide solution, hydrochloric acid, chromic acid solution and trichloroethylene in their NIOSH Pocket Guides and North American Emergency Response Guidebooks).

3. What type of PPE would be required by your own department in a similar incident?

Briefly review the Springfield, Massachusetts radiation case study. Then show Part 5 of the videotape with the news clip of this accident. Have the students discuss the following questions:

1. What is the primary hazard in this incident? What are the secondary hazards?

2. What type of PPE would have been appropriate for responding to this incident?

3. What type of PPE would be required by your own department in a similar incident?

4. Who would handle a similar incident in your own department? First responders, or the hazardous materials response team?

Activity 7-1

Have the students discuss the following questions about the Cleveland and Springfield case studies:

1. Was decontamination necessary in either of these incidents? If so, how would your department have handled it?

2. Assume that the Springfield incident had resulted in a radiation release. Would full decontamination or emergency decontamination be necessary? Briefly list your department's procedures for full decontamination and emergency decontamination.

Activity 7-2
Scenario

Time: 14:30 hours
Weather: Raining, windy, 37°F

Your EMS unit receives a call about a rail accident on an interstate. When you arrive, a police officer informs you that several rail cars have derailed and one, carrying a container of uranium hexafluoride, has overturned. The police officer and several other responders and bystanders have been close to the rail car. Several people have been complaining of watery eyes, shortness of breath, and nausea. You suspect that the container of UF 6 has been breached.

From your experience with uranium hexafluoride, you know that it is highly toxic and acidic, and very irritating to skin and eyes. You also know that it reacts vigorously with water to liberate corrosive fumes. You secure the scene and contact the local DOE radiological response team, your hazardous materials team, and other appropriate personnel, then turn your attention to those who are complaining of symptoms. One or two bystanders have become violently ill, and emergency decontamination is vital before you can treat them.

Below, list the steps you would take to perform emergency decontamination.

Activity 8-1

Briefly review the Cleveland, Ohio fire and the Springfield, Massachusetts radiation incident, then have the students work in small groups to diagram possible incident management systems for each. Remember
that there is no single “right” answer, and that an appropriate system reflects an individual department’s SOPs. Diagram a sample incident management system for your own department in the space below.

Activity 8-2

Ask the students to consider what would have happened in the Springfield case study if there had been a radiation release. Instruct them to revise their incident management systems to reflect this scenario. Revise your own diagram in the space below.

Activity 8-3

Ask the students to consider how their own departments would have responded to the two case study incidents.

Who would be responsible for establishing command?

Cleveland **Springfield**

Who would be responsible for collecting additional information on the hazards?

Cleveland **Springfield**

(Activity 8-3 continued)

Who would be responsible for isolating the hazards?

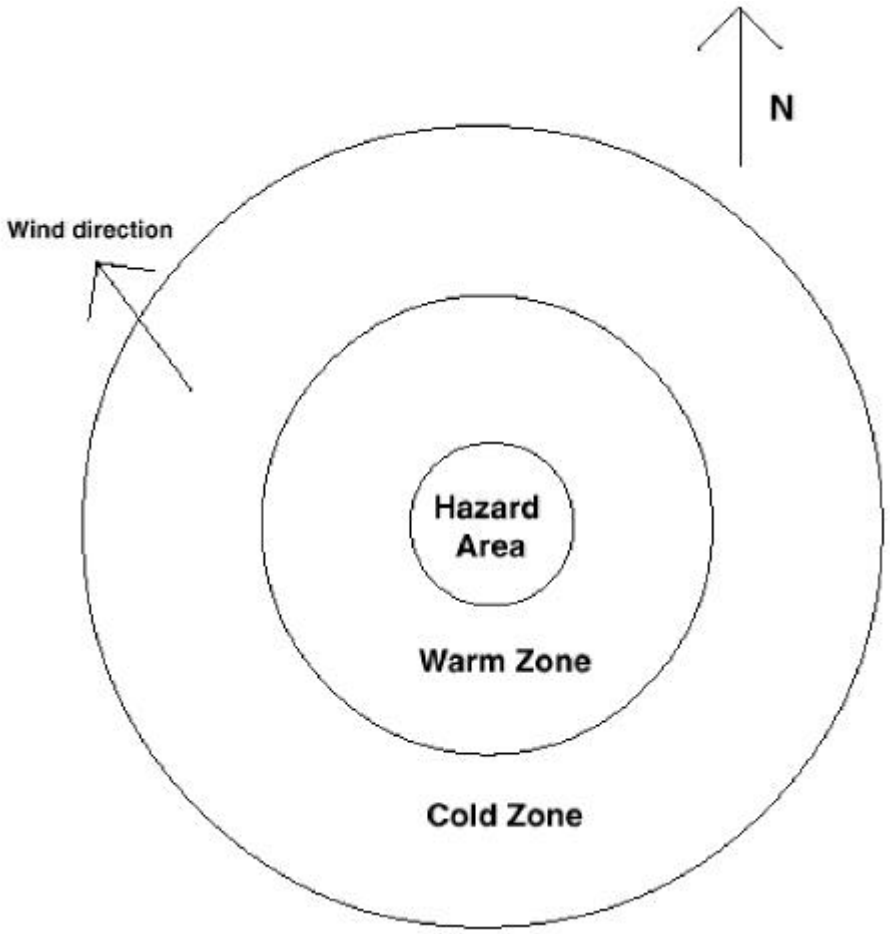
Cleveland **Springfield**

Identify an area in your jurisdiction where each of these incidents may have happened, and assess the vulnerable populations. Would you evacuate? Why or why not?

Cleveland **Springfield**

Activity 8-4

Draw the following zone diagram on the chalkboard. Divide the students into small groups. Tell them to select either case study and add the following information to the diagram: 1) Distances between zone perimeters; 2) staging of command post and engine companies; 3) decontamination area; 4) rehab area 5) entry and exit points



Activity 8-5

Replay Part 5 of the IAFF Training for Radiation Emergencies: First Responder Operations videotape with the news clip on the Aetna plating fire in Cleveland. Play the report from the news station, then ask the students to discuss how the incident was reported.

Replay Part 5 of the videotape with the news clip on the radiation accident in Springfield. Ask for two or three volunteers from the class to act as the public information officer for the Springfield incident. Ask them to respond to the following questions from reporters:

1. “How can we be sure this stuff won’t contaminate the city?

2. “How can you be sure those radiation containers are safe?”

3. “When can you get those bridges open? People need to get to work!”

4. “How can everything be running smoothly with all these people involved?”

Have the other students in the class ask additional questions.

Activity 8-6

Ask the students to consider how their own departments would have terminated each of the two case study incidents.

Who would be responsible for clean-up in your jurisdiction?

Cleveland **Springfield**

Who would conduct/attend the debriefing?

Cleveland **Springfield**

What records/reports would need to be completed or submitted?

Cleveland **Springfield**

Activity 9-2

Ask the students to assess the resources that would be available in their jurisdictions if they were to respond to incidents like those presented in the two case studies.

List the resources (equipment, trained personnel) that are available in your own department.

Cleveland	Springfield

List the resources available outside your department (e.g., agencies or departments with which you have mutual aid agreements).

Cleveland	Springfield

Slide Script

Unit 1 Slides

Transportation Alarms

Slide 1
There are thousands of highway shipments of hazardous materials every day, through nearly every community. When accidents happen, they usually involve flammable liquids. Where do accidents happen most often in your jurisdictions?

Slide 2
Most hazardous materials are carried in cargo tanks built to DOT specifications. This is a non-pressure cargo tank, or DOT 306, which carries gasoline. These are among the most common hazardous materials cargo tanks you'll see.

Slide 3
Highway vehicles may carry more than one placard. This is probably a compartmented cargo tank, carrying different products in each section. According to the placards, the vehicle is transporting isopropyl alcohol (1219); butyl alcohol (1120); petroleum naptha in two different sections (1255); and amyl methyl ketone (1110).

Slide 4
You can sometimes identify the type of product by the shape of the vehicle. For example, the relatively narrow design and stiffening rings identify this as a corrosive cargo tank carrying an acid or a base.

Slide 5
Other vehicles, however, may give no indication about their cargos. What could this vehicle transport?

Slide 6
Like highway transportation, rail shipments of hazardous materials may sometimes be obvious. This tank car for example, is stenciled with the name of ethylene oxide.

Slide 7
The shape of a container is another clue. This tube car is carrying compressed helium. What hazards might be involved if an accident occurred?

Slide 8
Trains can be especially dangerous because they carry large quantities. Sometimes the combinations of chemicals can be even more hazardous than any chemical alone.

Slide 9
Because of the unknown nature of transportation incidents, you should find out all you can about the hazardous materials that are likely to pass through your community.

Slide 10
Drills and periodic training will prepare you for actual incidents and enable you to assess the situation to determine if you should take action yourself or secure the scene until the hazardous materials team arrives.

Slide 11
This drill involved a radiological hazard and a corrosive material. The responder treating the victim is wearing splash protective gear for protection against the corrosive material, not the radiation hazard.

Unit 2 Slides

DOT Placards and Labels

Slide 12
These placards are used for highly explosive materials. Examples include dynamite, TNT, and black powder.

Slide 13
These placards are used for materials that are slightly less explosive. Examples include rocket motors and special fireworks.

Slide 14
These placards are used for materials such as propellant explosives and flash powders.

Slide 15
These placards are used for most fireworks and small arms ammunition.

Slide 16
This placard is used to identify ammonium nitrate and fuel oil (ANFO) mixtures.

Slide 17
This placard is used for very insensitive explosive materials.

Slide 18
This placard identifies flammable gases such as methane, propane and acetylene.

Slide 19
For domestic shipments, this placard identifies shipments of liquefied oxygen and compressed oxygen.

Slide 20
Examples of poison gases include arsine, phosgene, chlorine and methyl bromide. This placard is used when the LC_{50} is less than 5,000 ppm.

Slide 21
This placard is used when shipping flammable liquids such as gasoline, ethanol and acetone.

Slide 22
This placard is used with combustible liquids such as oils and fuel oils. No label is required.

Slide 23
Flammable solids include magnesium and nitrocellulose.

Slide 24
Spontaneously combustible products include phosphorus and other pyrophoric liquids and solids.

Slide 25
Materials that produce dangerous chemical reactions when they come in contact with water include sodium, potassium and calcium carbide.

Slide 26
This placard is used for materials that promote burning, such as hydrogen peroxide and potassium permanganate.

Slide 27
Organic peroxides include dibenzoyl peroxide and peroxyacetic acid.

Slide 28
This placard is used with poison liquids and solids such as aniline and arsenic.

Slide 29
This placard is used with slightly toxic hazardous materials that may be dangerous if ingested. Examples include nitrophenols and potassium fluoride.

Slide 30
The radioactive placard is used with materials such as thorium metal and uranium hexafluoride.

Slide 31
The radioactive I label is used for any radioactive material, depending on the packaging. NOTE: This is a radioactive I Label. A placard is not required.

Slide 32
The radioactive II label is also used for any radioactive material, depending on the packaging. NOTE: This is a radioactive II Label. A placard is not required.

Slide 33
Common corrosive materials include sulfuric acid, hydrochloric acid, and hydrogen fluoride.

Slide 34
The class 9 placard is used for other hazardous materials that don't fit into the preceding categories. These include a wide range of substances, such as dry ice, sulfur, and polychlorinated biphenyls.

Slide 35
The Dangerous placard is used when the total weight of two or more Table 2 materials is 1,001 pounds or more. If 5,000 pounds (2,205 pounds as of October, 1997) or more of any Table 2 materials are loaded at one location, the class placards must be used along with either a Dangerous placard or the class placard for the other materials.

Highway Carriers

Slide 36
Pressure cargo tanks have rounded ends that can withstand high pressures. They're sometimes painted a reflective color, such as white, and carry gases such as propane, butane, anhydrous ammonia and chlorine.

Slide 37
Low pressure cargo tanks have circular or horseshoe-shaped cross sections and flat ends. Horseshoe-shaped tanks like this one are often insulated. Many have rollover protection, as this one does. These cargo tanks usually carry almost all types of liquid chemicals.

Slide 38
This low pressure cargo tank has a circular cross-section and stiffening rings. It is essentially the same type of container as in the previous slide, but without insulation. These types of tanks look very much like corrosive liquid cargo tanks except they are larger in diameter.

Slide 39
Non-pressure cargo tanks have elliptical cross sections and flat ends. They're typically designed to withstand pressures of only 3 to 4 psig, although some can tolerate higher pressures. They're often compartmented, and carry petroleum products such as gasoline and fuel oil.

Slide 40
Corrosive liquid cargo tanks have a relatively small diameter and visible stiffening rings. The small size and stiffening rings are necessary because corrosives are generally heavier materials. Sodium hydroxide and sulfuric acid are common cargos.

Slide 41
Cryogenic liquid cargo tanks can usually be distinguished by their clean lines and valve cabinet in the rear. They usually have insulation, which may or may not be apparent. These cargo tanks often carry gases liquified through temperature reduction, such as liquid oxygen and liquid helium. Pressure relief valves can sometimes be seen above the valve cabinet on the rear.

Slide 42
Dry bulk hoppers carry dry materials such as fertilizers, oxidizers, and plastics, as well as a variety of other hazardous and non-hazardous materials. Occasionally they transport ammonium nitrate. They carry very heavy loads, and centrifugal force occasionally causes these vehicles to overturn.

Slide 43
Other cargo tanks have distinctive shapes, such as this tube trailer which is carrying compressed hydrogen. Gases in the tubes are compressed to about 5,000 to 6,000 psi.

Slide 44
Tractor-trailers carry virtually all types of solid products, as well as contained liquids.

Slide 45
Vans, pickups, flatbed trucks, and other types of vehicles might be carrying hazardous materials. But again, you won't know unless they're correctly placarded.

Railroad Tank Cars

Slide 46
Pressure tank cars look very similar to non-pressure tank cars, but there are differences. In this slide the smaller tank car on the right is a pressure car; the larger one is non-pressure.

Slide 47
The main difference between pressure and non-pressure tank cars is the top fittings. On pressure tank cars, the fittings are enclosed.

Slide 48
The enclosure must be opened for access to the valves and fittings. The enclosure protects the fittings in case of an accident.

Slide 49
On non-pressure tank cars, the fittings (such as the manway, valves and stuffing box that controls the valves) are exposed on top.

Slide 50
There are usually three or four fittings visible on top of non-pressure tank cars.

Slide 51
The white tank car with the black stripe is a corrosive liquid tank car. The stripe is made of corrosion-resistant paint to protect the car when it's filled from the top. However, it's not required so lack of a stripe does not mean the car isn't carrying a corrosive.

Slide 52
Cryogenic liquid tank cars usually have clean lines and jackets or insulation.

Slide 53
The fittings on cryogenic liquid tank cars are often located in a cabinet on the side of the car.

Slide 54
Boxcars can carry up to 100 tons of virtually any kind of material – hazardous as well as non-hazardous. Cars carrying hazardous materials are required to have placards.

Slide 55
Gondola cars are covered or uncovered cars with low sides and ends. They're used to transport bulk ores and other types of solids. Note the white cover ribs on this car.

Intermodal Containers

Slide 56
Intermodal containers carry liquid and solid materials. Fifty-five gallon drums or other large non-bulk containers are sometimes grouped into a single intermodal container.

Slide 57
Intermodal containers are occasionally called sea-land containers because they're designed to be carried in multiple transportation modes.

Unit 4 Slides

Uses of Radioactive Materials

Slide 58
Radioactive materials are used to generate much of the electrical power used in the U.S.

Slide 59
Physicians and others in the medical field use radioactive materials in the diagnosis and treatment of diseases. Radiation therapy is the treatment of cancer with sources of ionizing radiation. This is primarily x-rays and gamma rays, with occasional use of electron beams and, more rarely, proton beams. There are two basic procedures for irradiation of a patient: applying the radiation from the outside, with the source being some distance away from the patient; or implanting a sealed source of radioactive materials in the tumor or disease organ. Exterior treatment with cobalt was invented around 1950 using a sealed source of radioactive cobalt-60. This is a very high activity or strength of radioactive materials -- about 10 million times the strength used for implants. Most cobalt machines have been replaced by electron linear accelerators.

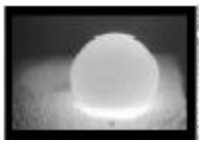
Slide 60
The modern linear accelerator produces both x-ray and electron beams of ionizing radiation. A daily treatment can be given in a few minutes. Usually the patient is treated 20 to 35 times. When the electric power is off there is no radiation production possible. These accelerators are kept in heavily shielded rooms.

Slide 61
This is a cesium-137 sealed source. It is 20mm or .8 inches long and has about 20 millicurie of radioactive cesium. It emits gamma rays. Three to five are used in an implantation. Sources are removed after two to three days.

Slide 62
The nylon strand in the center has Iridium-192 “seed” sources. These seed sources are 3.5 mm long and also emit gamma rays. They are used as implants to treat cancer.

Slide 63
Radioactive materials are used in weapons research. Specially-designed x-ray equipment in the domed building is being used to study the materials generated by the explosion in the foreground; the process is called flash radiography.

Slide 64
Some radioactive materials used in scientific research must be handled in gloveboxes similar to the one shown here.



Slide 65
Plutonium-238, which produces a tremendous amount of heat and has a half-life of 89 years, is used in space applications as a power source. This highly radioactive sphere is illuminated by its own energy. Remote handling is required when harmful amounts of radiation are emitted. This plutonium is used at the Savannah River site in South Carolina.

Slide 66
Radioactive materials are used in breeder reactors for testing fuels and other material,

Slide 67
and, of course, radioactive materials are used in nuclear weapons.

Slide 68
Shown here are many of the 6,000 parts of a B-61 nuclear bomb, spread in front of a partially disassembled weapon. A fully assembled weapon is in the background. DOE has disassembled some 50,000 nuclear weapons over the years in a safe, secure, efficient and environmentally sound manner.

Unit 5 Slides

Industrial Packaging

Slide 69
Industrial packaging is used for the least hazardous types of radioactive materials. Wooden crates are shown here, although other materials may be used for industrial packaging.

Slide 70
Industrial packaging often carries uranium or thorium ores and concentrates, consumer goods such as smoke detectors, and some radiopharmaceuticals.

Slide 71
Industrial containers must be able to protect their contents during normal transportation and handling, but not necessarily under severe accident conditions.

Type A Containers

Slide 72
Type A packages are used for shipping small quantities of radioactive materials with higher concentrations of radioactivity. (Note that this drum is not labeled correctly; the ORM label should not be included).

Slide 73
Although Type A containers carry more hazardous materials than that shipped in industrial packaging, serious radiation damage is unlikely even if a Type A package is involved in an accident.

Slide 74
If a radioactive material has other, more dangerous, properties it must be labeled and placarded accordingly. For example, this drum contains a cylinder of uranium hexafluoride. The corrosivity of UF_6 is much more of a threat than its radioactivity, so a corrosive placard is required.

Type B Containers

Slide 75
This Type B cask is used to transport fuel and structural core materials. Casks like this one can weigh about 90 tons when loaded. The container has a metal overpack attached on the right end. The overpack is a large energy absorber made of stainless steel and filled with foam. On impact, it absorbs energy and collapses, protecting the cask body.

Slide 76
This cask carries high-level spent fuel assemblies. It is 16 feet high, 8 feet in diameter, and has 15-inch thick walls made of ductile iron. It weighs 100 to 110 tons empty, and 115 to 125 tons loaded. Each cask holds 21 to 24 spent fuel assemblies. Casks are loaded in a spent fuel pool, sealed and decontaminated, and transported to a pad made of reinforced concrete.

Slide 77
Here you can see the spent fuel cannister in a different Type B transportation cask.

Slide 78
Here, a spent fuel cask is lowered into a licensed trailer and readied for trans-port.

DOE Shipments by Highway

Slide 79
Many radioactive shipments are carried in intermodal, or “sea-land” containers. The materials in intermodal containers don’t need repackaging if the shipment mode changes from highway to rail to water. On the highway, intermodal containers can be carrier on flatbed trailers, as shown here, or in van-type tractor trailers.

Slide 80
Highway shipments of DOE materials are highly regulated. Among other restrictions, carriers are required to follow the most direct interstate route, bypassing heavily populated areas when possible. Containers for radioactive waste are also strictly regulated to ensure safety. Note the tie-down straps securing these intermodal containers.

Slide 81
DOT placards are mandatory on all radioactive shipments. Other information may be required as well.

Slide 82
Many radioactive shipments of special nuclear materials are shipped in safe, secure, fixed-frame trailers called SSTs. Here, a standard 40-foot highway trailer is modified into a mobile vault.

Slide 83
Shipments of low level radioactive waste are rigorously inspected to make sure that any loose surface contamination is within DOT and NRC allowable limits.

DOE Shipments by Rail

Slide 84
This slide shows a “rainbow” train, which is used for transporting government-owned, special nuclear materials. These materials are carried in safe, secure rail cars, called SSRs, which are accompanied by escort coaches. The SSRs have safety features to minimize damage in case of an accident. They’re also armored and contain systems that detect penetration. The green-and-white escort coach serves as a living and command post for couriers, and provides a tactical vantage point for viewing the SSRs.

Slide 85
Uranium hexafluoride is often shipped on intermodal “flat racks” that can be transported by rail, highway, or water. The container carries a corrosive placard in addition to the radioactive placard. The corrosivity of UF_6 is much more hazardous than its radioactive properties.

Slide 86
This covered shipping cask is being transported on an open flatcar. Each cask holds about seven canisters containing fuel and core material. The casks weigh about 90 tons when fully loaded.

Slide 87
When shipping large quantities of radioactive materials, rail transport is often more efficient. A quantity that would require 250 highway shipments may need only 40 rail shipments.

Storing Radioactive Waste

Slide 88
In the past, bags and boxes of contaminated radioactive waste were often dumped into unlined trenches for burial.

Slide 89
Today's disposal methods are more environmentally sound. All radioactive waste is examined, packaged, and isolated in steel drums or other leak-proof containers. These containers are then encapsulated in concrete vaults and buried in silos, or placed on concrete pads.

Slide 90
These storage tanks at DOE's Hanford site in the state of Washington are concrete-reinforced, double-shell containers. Each has a capacity of a million gallons of liquid radioactive waste. The carbon steel shells are constructed one inside the other to guard against leakage. The space between the tanks is monitored to detect any leakage of waste materials from the inner tank. These storage tanks have been covered with seven to ten feet of earth.

Slide 91
The fused product – the glass – is then sealed in canisters like this one before being transported to permanent storage facilities. This container is from the Defense Waste processing facility at Savannah River in South Carolina.

Slide 92
Currently, spent fuel is stored onsite in pools of water, as shown here, or in above ground vaults or casks.

Slide 93
Transuranic waste is low-level material, but it is radioactive for relatively long periods of time. Examples are plutonium or uranium-contaminated rags, work clothing, metal scraps and paper. It's often shipped in drums in containers like the one shown here.

Slide 94
One storage facility for transuranic waste is the Waste Isolation Pilot Plant – WIPP — in New Mexico.

Slide 95
Storage rooms at WIPP are carved from thick salt beds about 2,000 feet below the earth's surface.

Slide 96
These metal scraps from a demolished building at the Fluor Daniel Fernald uranium processing plant in Cincinnati are contaminated with low levels of radiation. Eventually they will be loaded into gondola rail cars and shipped to a permanent disposal facility.

Slide 97
Drums are often packed into other containers,

Slide 98
which are then buried at approved sites.

Slide 99
Yucca Mountain in Nevada is one example of a permanent radioactive waste repository. The earth here has good physical and chemical properties for nuclear waste containment.

Unit 9 Slides

Ask the students what hazards they would expect to find if they pre-incident planned these sites.

Slide100
Hazards: Virtually any type of hazardous materials, including illegal materials.

Slide 101
Hazards: Flammable liquids, and almost any other chemical.

Slide 102
Hazards: Solvents and other flammable liquids.

Slide 103
Hazards: Lab materials, pool chemicals.

Slide 104
Hazards: Radioactive materials; possibly other chemicals.

Slide 105
Hazards: Radioactive materials, compressed gases, various chemicals.

Slide 106
Hazards: Virtually any chemical.

Slide 107
Hazards: Chlorine.

Slide 108
Hazards: Large supplies of cleaning chemicals, pool chemicals, various hazardous products of combustion from furnishings, possible hazards in guests' property.

Slide 109
Hazards: Freon and other refrigerants; compressed gases.

Slide 110
Hazards: Pesticides, compressed gases, fertilizers.

Slide 111
Hazards: Perchloroethylene, solvents and other flammable liquids

Speaker Notes

Speaker Notes

Identify the agency that has jurisdiction over radiation incidents that occur in this area.

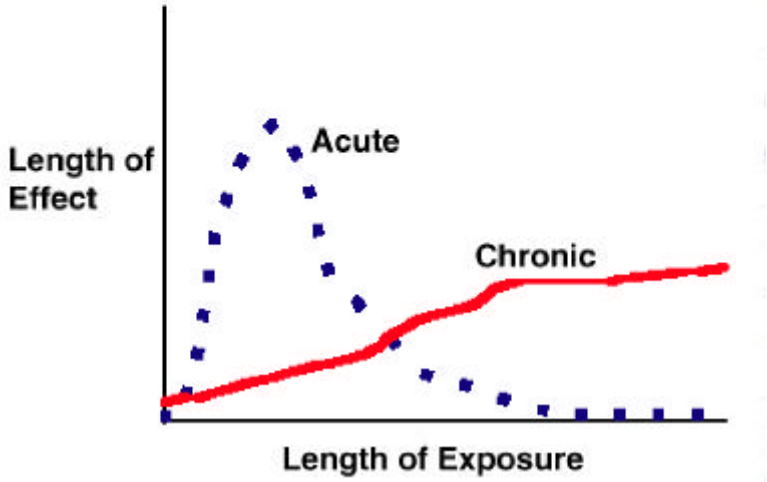
Identify the local/regional/federal agencies that responders are required to contact if they respond to an accident involving radioactive materials.

Identify the resources that responders can contact for additional information on radiation hazards.

Agency	Telephone Number
Jurisdictional agency:	
Required contacts:	
Information sources:	

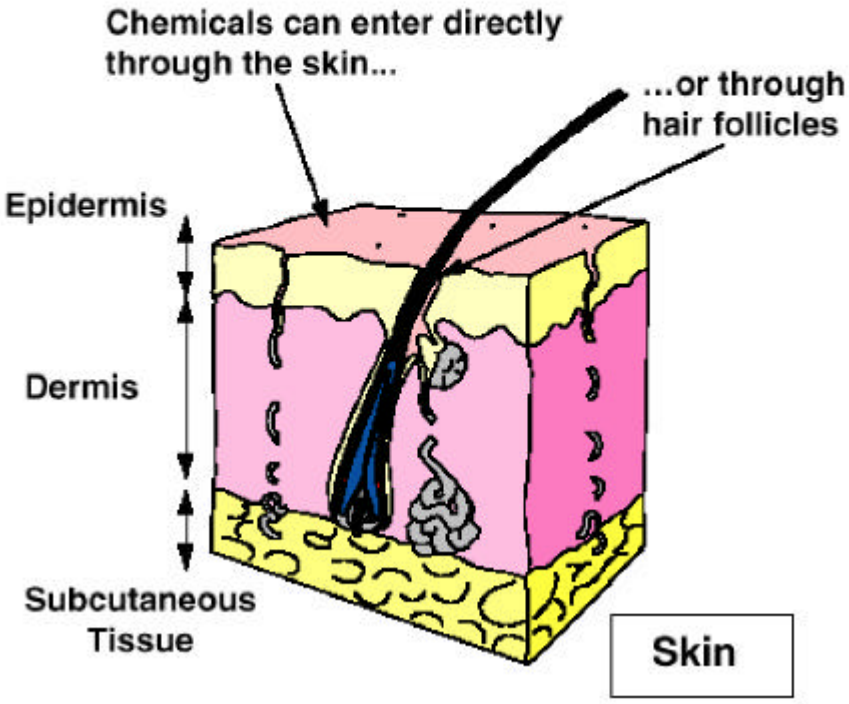
Transparencies

Acute vs. Chronic Effects



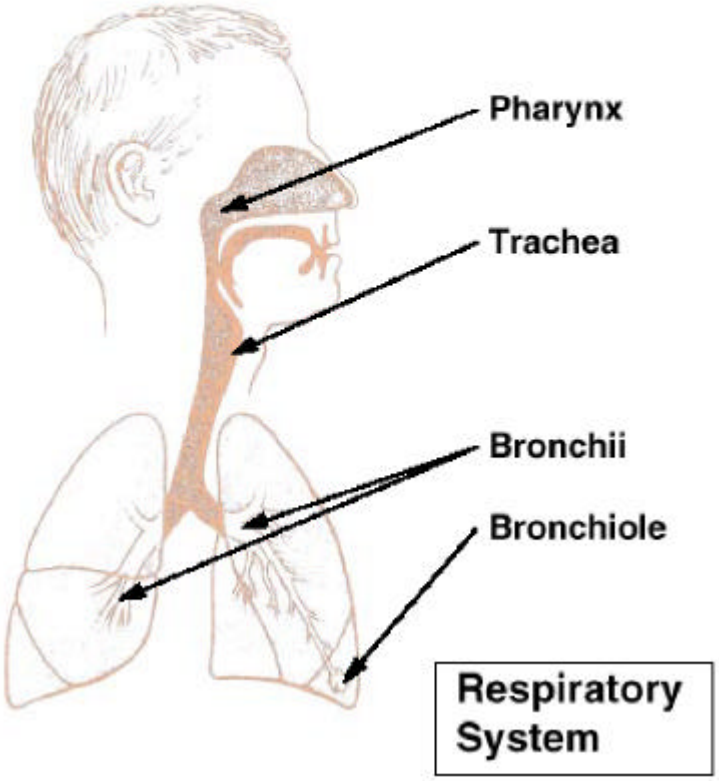
Transparency 1-1

Routes of Exposure: Direct Contact

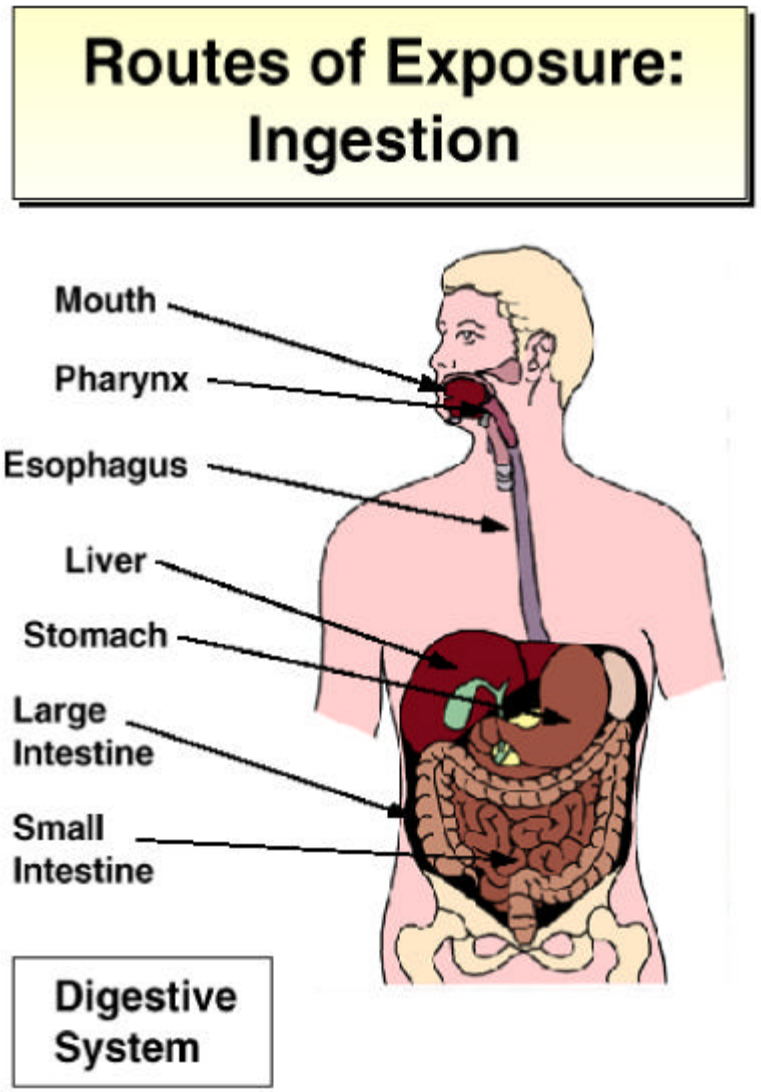


Transparency 1-2

Routes of Exposure: Inhalation



Transparency 1-3



Transparency 1-4

DOT Table 1 Materials

If material is classed as:	It must be placarded as:
Explosive (Div 1.1)	Explosive
Explosive (Div 1.2)	Explosive
Explosive (Div 1.3)	Explosive
Poison gas (Div 2.3)	Poison gas
Dangerous when wet (Div 4.3)	Dangerous when wet
Toxic materials and infectious substances (Div 6.1)	Poison (Toxic)
Radioactive (Class 7, in Radioactive III packaging)	Radioactive

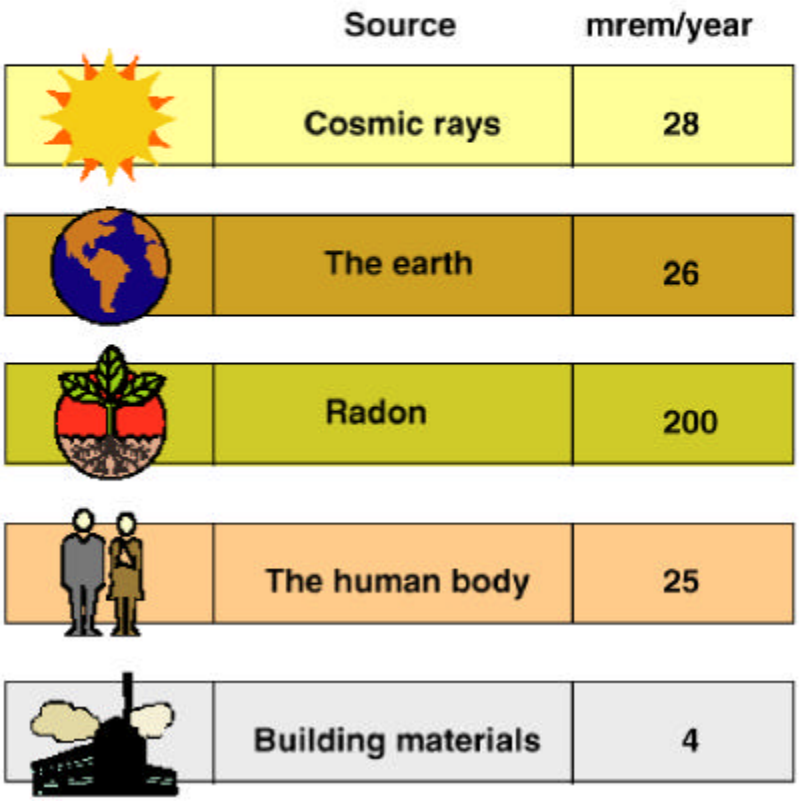
Transparency 2-1

DOT Table 2 Materials

If material is classed as:	It must be placarded as:
Explosive (Div 1.4)	Explosive
Explosive (Div 1.5)	Blasting agent
Explosive (Div 1.6)	Explosive
Non-flammable gas (Div 2.2)	Non-flammable gas
Oxygen (Div 2.2)	Oxygen
Flammable gas (Div 2.1)	Flammable gas
Combustible liquid	Combustible
Flammable liquid (Class 3)	Flammable
Flammable solid (Div 4.1)	Flammable solid
Oxidizer (Div 5.1)	Oxidizer
Organic peroxide (Div 5.2)	Organic peroxide
Toxic materials and infectious substances (Div 6.1)	Poison (Toxic)
Corrosive (Class 8)	Corrosive
Irritating	Dangerous

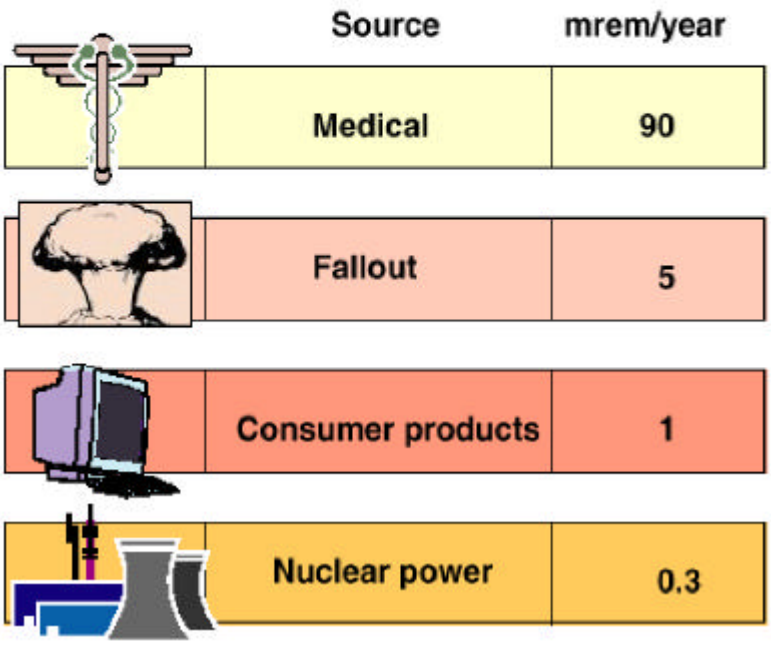
Transparency 2-2

Radiation from Natural Sources



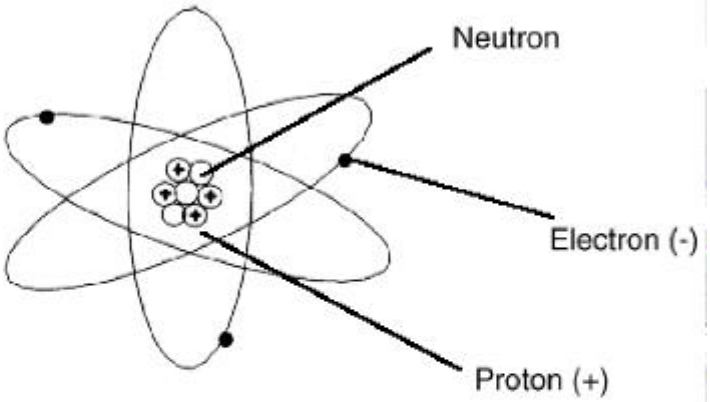
Transparency 4-1

Radiation from Manmade Sources



Transparency 4-2

Parts of an Atom



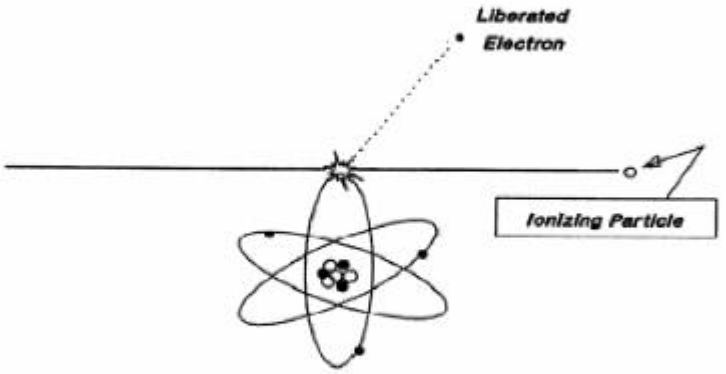
The nucleus contains positively charged protons and neutrons, which are not charged

Orbiting electrons are negatively charged

When the number of protons and electrons are equal, charges are balanced and the atom is stable

Transparency 4-3

Ionization



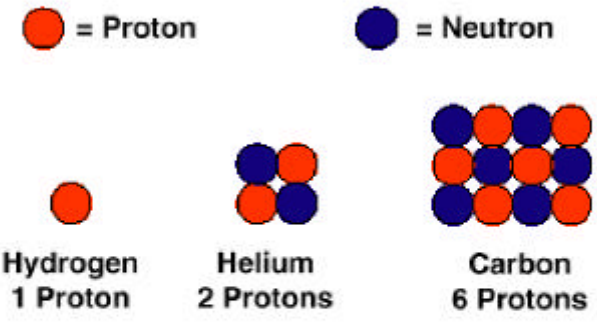
An electron can be knocked from its orbit

The atom becomes charged, or "ionized"

Transparency 4-4

Atoms

Elements are defined by the number of protons



1. What elemental nuclei are these?

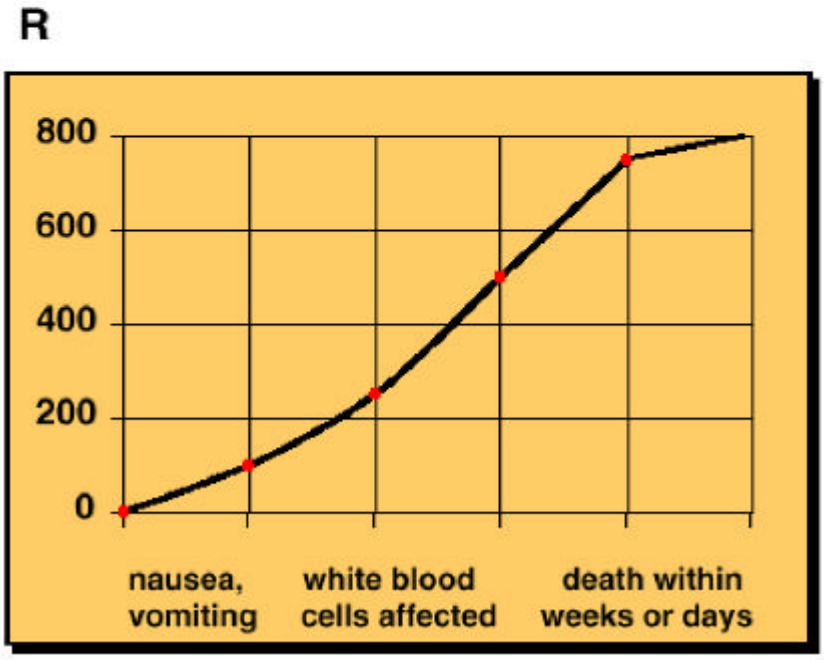
2. How many neutrons does Carbon 60 have?

3. How many neutrons and protons does Carbon 13 have?

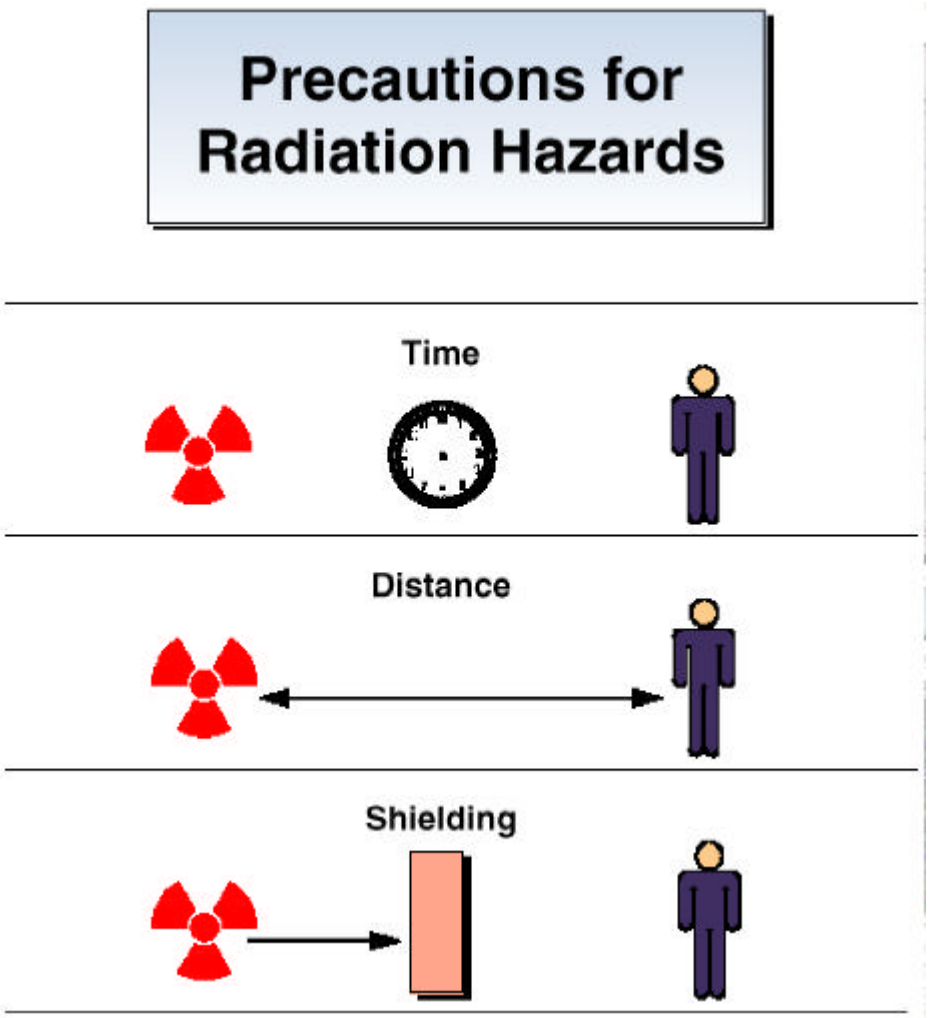
Answers:
1. Because they have only one proton, all these nuclei are different isotopes of hydrogen
2. Carbon 60 has 54 neutrons (plus 6 protons)
3. Carbon 13 has 7 neutrons and 6 protons

Transparency 4-5

Stages of Acute Radiation Syndrome



Transparency 4-6



Transparency 4-7

Placards/Labels for Radioactive Materials

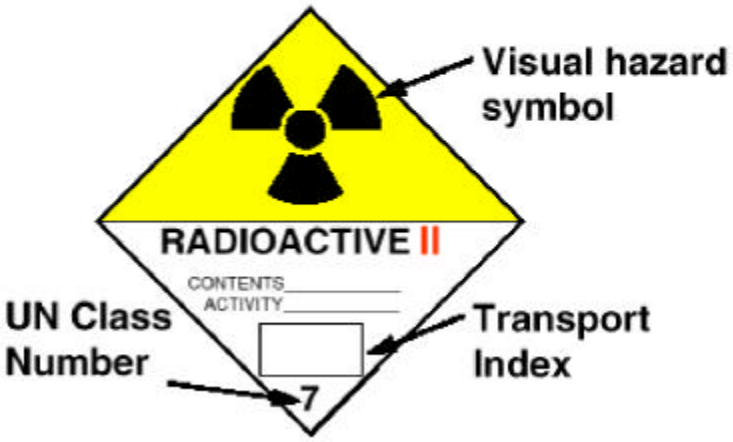
Radioactive white - I
Contains almost no radiation (0.5 mR/hr on surface)

Radioactive yellow - II
Low radiation levels (50 mR/hr maximum on surface; 1 mR/hr maximum at 1 meter)

Radioactive yellow - III
Higher radiation levels (200 mR/hr maximum on surface; 10 mR/hr maximum at 1 meter)

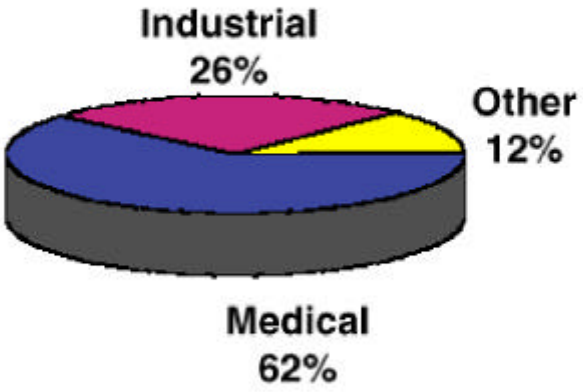
Transparency 5-1

Transport Index



Transparency 5-2

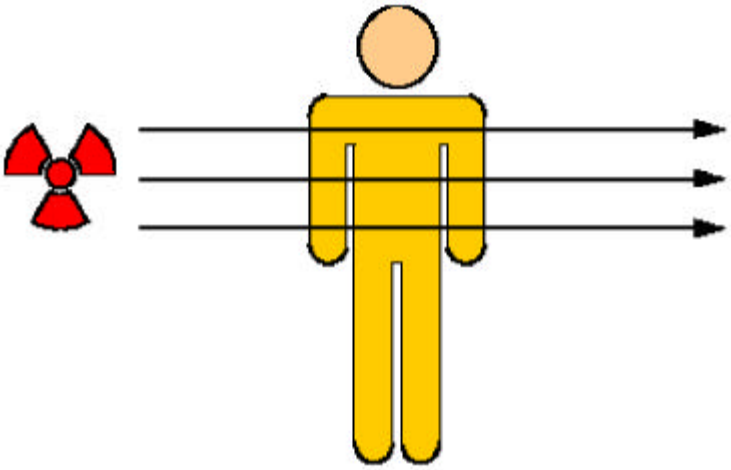
Radiological Shipments by Industry



"Other" includes fuel rods, fissile materials, utility waste, and military shipments

Transparency 5-3

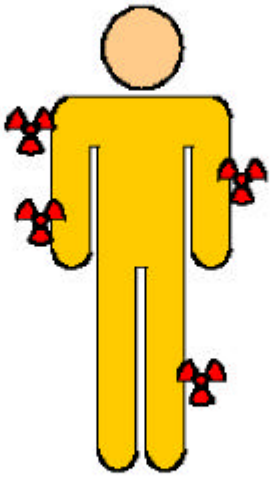
Exposure to External Sources



Patients exposed to external sources of radiation do not pose contamination problems

Transparency 6-1

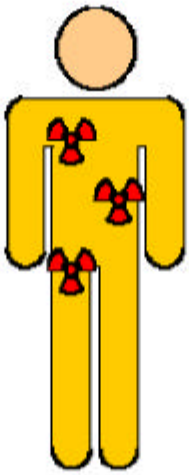
External Contamination



Externally-contaminated patients should be checked with radiation meters and given on-scene emergency care ASAP

Transparency 6-2

Internal Contamination



Internally-contaminated patients must be given medical care for injuries but there is little you can do to treat radiation exposures

Transparency 6-3

Recognition and Identification Quiz

Recognition and Identification Quiz

1. Which hazard class is identified by this placard?

2. Which color identifies the Combustible hazard class?

3. Which hazard class is identified by this placard?

4. Which color identifies the Oxidizer hazard class?

5. Which hazard class is identified by this placard?

6. Which hazard class is identified by this placard?

7. List three hazard classes identified by this symbol:

_____

_____

_____

8. What does this symbol identify?

_____

9. Which hazard class is identified by this placard?

_____

10. Which hazard class does this symbol identify?

_____

11. The hazard class name may be replaced with the:

_____

12. Which hazard class is identified by this placard?

_____

13. When is this placard used?

_____

14. Hazardous materials that must be placarded include:

_____

_____

_____

_____

_____

_____

_____

15. What kind of materials are identified by a solid blue placard?

_____

16. _____ and _____ are identified by a solid yellow placard.

17. List the 9 DOT hazard classes.

1) _____

2) _____

3) _____

4) _____

5) _____

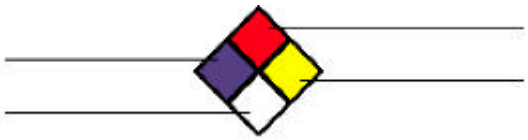
6) _____

7) _____

8) _____

9) _____

18. List the hazard designated by each section of the NFPA diamond.



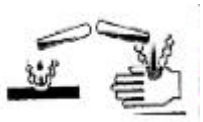
19. List the meanings of the following abbreviations that are sometimes found on the NFPA 704 diamond.

OX _____

ALK _____

COR _____

20. Which hazard class does this symbol identify?



Recognition and Identification Quiz Answer Key

ANSWER KEY

1. **Explosives** are identified by orange placards.

2. **Red** identifies Combustibles.

3. **Non-flammable gases** are identified by green placards.

4. **Yellow** identifies Oxidizers.

5. **Radioactive** materials are identified by yellow and white placards.

6. **Poison** gases, **toxic** materials, **harmful** substances and **infectious** substances are identified by white placards.

7. The flame identifies:
   A. **Flammable**
   B. **Combustible**
   C. **Spontaneously combustible**
   D. **Dangerous when wet**

8. **Flammable solids** are identified by 

9. **Corrosives** are identified by white and black placards.

10. **Poison and toxic materials** are identified by a skull and cross bones.

11. The **UN number** may replace the hazard class name.

12. **Flammable solids** are identified by red-and-white striped placards.

13. A **Dangerous** placard is used when two or more Table 2 materials are shipped together.

14. Hazardous materials that must be placarded include:
    Explosives (Division 1.1)
    Explosives (Division 1.2)
    Explosives (Division 1.3)
    Poison gas (Division 2.3)
    Dangerous when wet (Division 4.3)
    Toxic materials and infectious substances
    Radioactive

15. **Dangerous when wet** materials are identified by solid blue placards.

16. **Oxidizers** and **oxygen** are identified by solid yellow placards.

17. The nine DOT hazard classes are:
    - **Class 1 – Explosives**
    - **Class 2 – Gases**
    - **Class 3 – Flammable liquids (and combustible liquids in the U.S.)**
    - **Class 4 – Flammable solids; spontaneously combustible materials; dangerous when wet materials**
    - **Class 5 – Oxidizers and organic peroxides**
    - **Class 6 – Toxic/poison materials and infectious substances**
    - **Class 7 – Radioactive materials**
    - **Class 8 – Corrosive materials**
    - **Class 9 – Miscellaneous dangerous goods**

18. **Flammability** is indicated by the red diamond.
    Reactivity is indicated by the yellow diamond.
    Special hazards are indicated by the white diamond.
    Health hazards are indicated by the blue diamond.

19. OX indicated **Oxidizer**.
    ALK indicates **Alkaline**.
    COR indicates **Corrosives**.

20. **Corrosives** are indicated by the hand and test tube symbol.

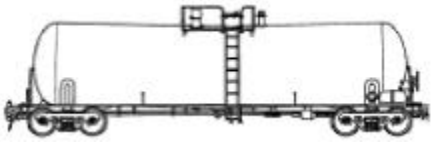
Pre/Post Test

1.) Which of the following types of radiation can pass through paper but not aluminum foil?

a) Alpha particles
b) Beta particles
c) Gamma rays
d) X-rays

2.) The railroad tank car pictured here is a:

a) Non-pressure
b) Pressure
c) Corrosive liquid
d) Cryogenic liquid



3.) Which of the following types of radiation has the largest mass?

a) Alpha
b) Beta
c) Gamma rays
d) X-rays

4.) The railroad tank car pictured here is a:

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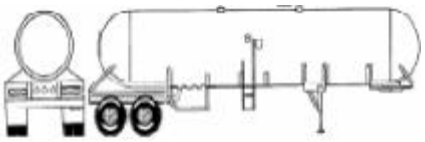
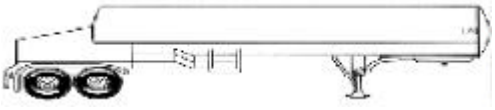


5.) Which of the following must be placarded regardless of the amount being transported?

a) Table 1 materials
b) Table 2 materials
c) Any corrosive material
d) Any class 9 material

6.) The railroad tank car pictured here is a:

a) Non-pressure
b) Pressure
c) Corrosive liquid
d) Cryogenic liquid



7.) Atoms with the same number of protons but different numbers of neutrons are called:

a) Photons
b) Ions
c) Isotopes
d) Free radicals

8.) A placard with the hazard class number 8 at the bottom of the placard indicates a:

a) Radioactive material
b) Flammable liquid
c) Flammable solid
d) Corrosive

9.) The highway cargo tank pictured here is a:

a) Non-pressure MC 306/DOT 406
b) Low-pressure MC 307/DOT 407
c) Corrosive liquid MC 312/DOT 412
d) Pressure MC 331

10.) According to the EPA, authorization is required for life-saving operations if the number of rems exceeds:

a.) 10
b.) 25
c.) 50
d.) 100

11.) Special form radioactive materials are:

a) Always shipped in Type B containers
b) Packaged in sealed capsules
c) Used in reactors
d) Fissile materials

12.) Gases or vapors with a vapor density less than 1 will:

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b) Rise in air
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13.) A readily available resource for dealing with an incident involving poisonous gas, specific recommendations for evacuation distances, is the:

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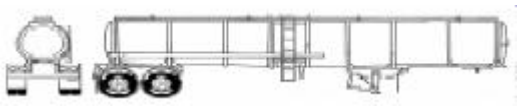
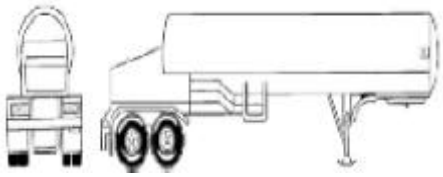


15.) A product with a Class Division number of 5.2 at the bottom of the placard would be considered a (n):

a) Poisonous material
b) Organic peroxide
c) Oxidizer
d) Infectious substance

16.) The highway cargo tank pictured here is a:

a) Cryogenic liquid MC 338
b) Tube trailer
c) Dry bulk commodity carrier
d) DOT spec. 51



17.) Nickel and formaldehyde, which can cause allergic reactions after repeated exposures, are examples of:

a) Carcinogens
b) Irritants
c) Sensitizers
d) Neurotoxins

18.) According to the DOT, a flammable gas:

a) Has an LEL < 12% or a Flammable Range > 13%
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c) Has an LEL < 14% or a Flammable Range > 15%
d) Has an LEL < 15% or a Flammable Range > 14%

19.) The Inverse Square Law is based on which of the following principles?

a) If shielding density doubles, the rate of exposure is reduced by 1/4.
b) If time near a source is reduced by half, so is the rate of exposure.
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20.) Radioactive - Yellow III categories always:

a) Indicate maximum permissible radioactivity of 0.5 mrem / hr on the package surface
b) Require a placard on the vehicle transporting the package
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22.) The “Dangerous” placard is used when:

a) Less than 1001 lbs of Radioactive materials are on board
b) Less than 1001 lbs of Flammable Gas is on board
c) A shipment contains a mixed load of table 2 materials
d) A shipment contains a mixed load of table 1 materials

23.) On a radiation label the *activity* line indicates:

a) The type of material in the package
b) The level of radiation
c) The half-life of the material
d) The amount of rems, rads, or roentgens

24.) A complete Material Safety Data Sheet must contain all of the following except:

a) The name of the chemical
b) The quantity of the material being transported
c) Data about the health effects of the material
d) Information about the material's physical properties

25.) Rem measures a quantity called:

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b) Absorbed dose
c) Whole dose
d) Penetrating dose

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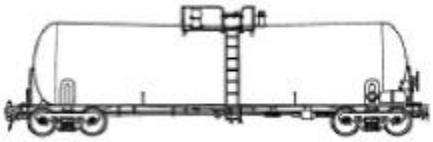

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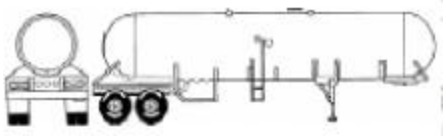

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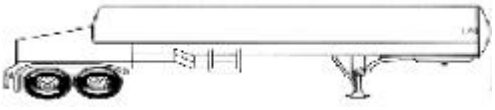

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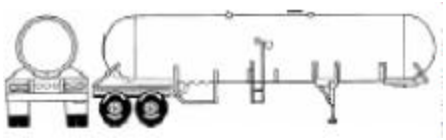

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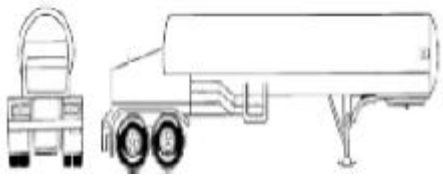

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